METHOD AND APPARATUS FOR COMPENSATING COLOR IN THE DISPLAY DEVICE OF A USER'S TERMINAL THROUGH THE NETWORK

[Technical Field]

The present invention relates to a method and apparatus for altering colors on a display device and, more particularly, to a method and apparatus for altering colors on the display device of a user's terminal.

[Background Art]

Currently, with the popularization of computers, changes in network environments, the expansion of the information processing capability of information terminals, and the digitization of various multimedia information, anyone can easily make use of multimedia. Accordingly, the multimedia industry is rapidly developing, and a demand for multimedia content, such as educational multimedia content, multimedia publication content, game content and digital albums, is greatly increasing.

In the meantime, small-sized information terminals, such as notebook computers, personal digital assistants and mobile phones, as well as televisions and Personal Computers (PCs) can perform high-image quality multimedia processing. With the popularization of a wireless Internet

environment, users are increasingly coming into contact with much multimedia content. In the future, mobile information terminals will lead to the development of information service user-oriented products in light of convenience and mobility. In particular, information terminals that take mobility and portability into account to satisfy users' convenience are provided with performance similar to that of PCs, and are being developed into smart information terminals that provide magnificent interfaces to enable multimedia services or wireless Internet searches, that are small and light, and that are provided with a variety of services while users are moving.

In the multimedia age, color not only serves as a tool to decorate content but also performs an important function of enabling humans to easily and effectively perceive the information of content. However, in the multimedia age, as the transmission of information via color increases and is diversified, the inconvenience that color deficient persons experience is also increasing. The above-described desirable functions that color provides as an information transmission medium act as undesirable functions for color deficient persons.

While normal persons enjoy the benefits of multimedia content, color deficient persons are alienated from the benefits of multimedia content, and practical countermeasures for color deficient persons are

insufficient. In order to solve the problem, the development of a color alteration system for color deficient persons is demanded.

The number of color deficient persons is approximately 8% of the world's population (approximately 10% of men and approximately 1% of women). This ratio is not less than that of any handicap. The reason for this is that there is no medical measure to cure color vision deficiency and parents' color vision deficiency characteristics are inherited by children.

Accordingly, many persons have difficulty viewing colors. In particular, in the case where various pieces of visual information in content have can be distinguished only by color, very serious results may be brought about. Nevertheless, colors are used throughout society in multimedia content, such as in a still image, a moving image, a web page and a digital document, without consideration given to users having color vision deficiency. Therefore, efforts to provide high-grade content, which is identical to that that is provided to normal persons, to the members of society who may be easily alienated in a flood of multimedia content are necessary.

Research into improvement in the color perception capability of color deficient persons trends toward schemes in which the color deficient persons perceive colors through display devices. Of the schemes, the World Wide Web

Consortium (W3C), that is, an Internet based World Wide Web service-related international standardization organization, presents several guidelines about the production of web content for color deficient persons. However, the guidelines present only detailed description items but do not provide strategic alternatives, such as an effective design method or a method of producing a reusable process.

Microsoft Corporation proposed several items to be checked to take color deficient persons into account at the time of software production. However, the items proposed by Microsoft Corporation are merely recommendation items to be observed at the stage of content or software production. Lots of content and software are not produced in conformity with the recommendation items, and content is produced without regard to the recommendation items. Furthermore, since there are technical limitations in the production of content, such as real-time video, it is not possible to provide a color alteration service to color deficient persons using the preceding schemes.

An existing technology for assisting color deficient persons in effectively distinguishing colors in daily life includes a method of wearing color glasses that filters colors in a specific wavelength region. By allowing color deficient persons to wear the color glasses and view objects, colors are effectively distinguished from each other. However, this method is problematic in that colors

that the color deficient persons can normally view are changed, and disadvantageous in that it is difficult to take the various degrees of color weakness into account.

[Disclosure of the Invention]

Accordingly, an object of the present invention is to provide a method and apparatus for rapidly and easily diagnosing a user's color vision deficiency characteristics via a network.

Another object of the present invention is to provide a method and apparatus for rapidly and precisely altering colors on a display device provided in the user's terminal so that the user having color vision deficiency can obtain the same color information as a normal person.

In order to accomplish the above object, the present invention provides a method and apparatus for enabling a user having color vision deficiency to normally view all the colors displayed on a display device in such a way as to automatically diagnose color vision deficiency via the web, generate an automatic color alteration palette based on the diagnosis results, and install the automatic color alteration palette in the display device provided in a user's terminal, so as to provide altered colors to a person having color weakness as well as a color blind person.

The present invention provides a method of altering colors on the display device of a user's terminal via a network, including the steps of performing a color vision test on the user via the network, diagnosing the characteristics of the user's color vision deficiency based on the results of the color vision test, generating a color alteration palette for the user's terminal based on the diagnosed characteristics of the user's color vision deficiency and the characteristics of the user's terminal, and providing the generated color alteration palette to the user's terminal via the network.

In the present invention, the color vision test may be implemented based on the World Wide Web (WWW). The step of providing the color alteration palette may be performed by providing the created color alteration palette in the form of a computer program that is installed on the user's terminal. The color vision deficiency characteristics may be composed of the user's color vision deficiency type and degree. The color alteration palette may be restrictively used for display performed by a specific application program. The color vision deficiency characteristics may be described based on a Moving Picture Experts Group (MPEG) standard.

The present invention may further include the steps of transmitting the color vision test results to a medical expert's terminal, and receiving the user's color vision

deficiency characteristics diagnosed by the medical expert from the medical expert's terminal, and comparing the automatically diagnosed color vision deficiency characteristics with the color vision deficiency characteristics diagnosed by the medical expert, and accepting the color vision deficiency characteristics diagnosed by the medical expert as the user's color vision deficiency characteristics if the automatically diagnosed color vision deficiency characteristics are different from the color vision deficiency characteristics diagnosed by the medical expert. Furthermore, the present invention may further include the step of updating the database using the color vision deficiency characteristics diagnosed by the medical expert if the color vision deficiency characteristics automatically diagnosed using the database are different from the color vision deficiency characteristics diagnosed by the medical expert.

The step of diagnosing the color vision deficiency characteristics may include the steps of transmitting the color vision test results to a medical expert's terminal, and receiving the user's color vision deficiency characteristics diagnosed by the medical expert from the medical expert's terminal. The present invention may further include the step of generating a database for storing the relationships between the color vision test results and the color vision deficiency characteristics,

wherein the step of diagnosing the color vision deficiency characteristics is automatically performed by comparing the color vision test results with the color vision test results stored in the database.

The present invention provides an apparatus for altering colors on the display device of a user's terminal via a network, including a network access unit for accessing the user's terminal via the network, a means for performing a color vision test on the user, a means for diagnosing the characteristics of the user's color vision deficiency based on the results of the color vision test, a means for generating a color alteration palette for the user's terminal based on the diagnosed characteristics of the color vision deficiency and the characteristics of the user's terminal, and a means of providing the generated color alteration palette to the user's terminal via the network.

The present invention having the above-described features has the following advantages. First, color alteration is performed to a varying degree according to a user's color vision deficiency characteristics, so that colors optimized to the user's color vision deficiency characteristics can be provided to the user. In the reality in which wired/wireless network infrastructure is developed and information terminal devices, such as a computer, a notebook computer, a digital Television (TV), a Personal

Digital Assistant (PDA), a mobile phone and a hand-held Personal Computer (PC), are personalized more and more, it is necessary that even the same content be adaptively converted according to the user's preference and transmitted. If such a technology is developed, the age in which content suitable for an individual may be received anytime and anywhere by transferring personal information to an adaptive conversion device may come.

Second, since color alteration is performed in the color deficient user's multimedia terminal, the color alteration does not hinder a content producer or designer from creating content.

Third, a precision color vision test, which has not been widely used because it takes a long time though its precision is high, is performed on a web basis using a computer, so that a color vision test and diagnosis can be easily and rapidly performed. The main problem with the precision color vision test is that the precision color vision test takes a long time. Furthermore, there are not many hospitals that have purchased high-priced test equipment, such as an anomaloscope that is known to be the most precise equipment. Since the precision test methods are not generally and widely used, most of the testees are not accustomed to such precision test methods. Accordingly, the precision of the tests may be reduced due to the users' lack of experience with the tests.

Fourth, in accordance with the present invention, it is easy to manage and analyze color vision test information and color vision test results can be exchanged over a color alteration system and a network, so that more rapid and precise color alteration can be performed.

[Brief Description of the Drawings]

With reference to the accompanying drawings, the embodiments of the present invention are described in detail below. In the drawings, the same reference characters are used to designate the same or similar elements or signals.

FIG. 1 is a diagram showing the construction of an entire color vision deficiency diagnosis and color alteration system;

FIG. 2 is a flowchart showing an entire color vision deficiency diagnosis and color alteration process according to the present invention;

FIG. 3 is a detailed flowchart showing the user authentication step of FIG. 2;

FIG. 4 is a diagram showing the details of user registration information according to the present invention;

FIG. 5 is a detailed flowchart showing the color vision test step and color vision deficiency diagnosis step of FIG. 2;

FIG. 6 is a detailed flowchart showing the doctor's precision diagnosis step of FIG. 5;

FIG. 7 is a detailed flowchart showing the color alteration palette generation and provision step of FIG. 2; and

FIG. 8 is a detailed flowchart showing the color alteration step of FIG. 2.

[Best Mode for Carrying Out the Invention]

FIG. 1 is a diagram showing the construction of an entire color vision deficiency diagnosis and color alteration system. As shown in this drawing, a color vision deficiency diagnosis and color alteration apparatus 100 is connected to a user's terminal 102 and a medical expert's terminal 104 via a web connection. The color vision deficiency diagnosis and color alteration apparatus 100 includes a main web server 106, a user authentication unit 108, a color vision test unit 110, a precision diagnosis unit 112, a color alteration palette generation unit 114 and a database unit 116. The user's terminal 102 includes a user's web access terminal unit 118, a color alteration unit 120 and a display unit 122.

FIG. 2 is a flowchart of an entire color vision deficiency diagnosis and color alteration process according to the present invention. With reference to FIGS. 1 and 2,

the entire color alteration process according to the present invention is described.

First, the user accesses the main web server unit 106 of the color vision deficiency diagnosis and color alteration apparatus 100 via the wired/wireless Internet using the user's web access terminal unit 118. The user transmits and receives information through the main web server unit 106, and the main web server unit 106 relays information exchange between the user's terminal 102 and the principal parts of the color vision deficiency diagnosis and color alteration apparatus 100. When the user accesses the color vision diagnosis and color alteration apparatus 100 through the main web server unit 106, user authentication is performed in the user authentication unit 108 at step S202, an authenticated user takes a web-based color vision test using the color test unit 110, color vision test results are stored in the database unit 116 when the user finishes the color vision test, and an automatic color vision deficiency diagnosis is performed on the color vision test results using statistical data stored in the database unit 116. To perform a precision diagnosis, a doctor's (or a medical expert's) additional diagnosis process is performed in the precision diagnosis unit 112. The precision diagnosis unit 112 provides color vision test results and color vision deficiency diagnosis results to the medical expert's terminal 104 through the color vision

test unit 110 and the main web server unit 106, and the doctor's precision diagnosis results are provided by the medical expert's terminal 104. The color vision deficiency results are transferred to the color alteration palette generation unit 114, the color alteration palette generation unit 114 generates a color alteration palette that is optimized to the characteristics of the user's color vision deficiency and the characteristics of the display unit 122, and the generated color alteration palette is provided to the user's terminal 102 through the main web server unit 106 at step S208. The color alteration palette is installed in the color alteration unit 120 of the user's terminal 102, and performs an operation of altering colors on the display unit 122 at step S210.

FIG. 3 is a detailed flowchart showing the user authentication step S202 of FIG. 2. In order to perform user authentication, the user inputs the user's Identification (ID) and password using the input device (not shown) of the user's web access terminal unit 118 at step S302, and the apparatus 100 examines whether the user is an authenticated user using the input ID and password at step S304. Since information about the authenticated user is stored in the database unit 116, the user's ID and password stored in the database 116 are referred to so as to perform user authentication. If, as a result of the reference, the user is the authenticated user 350, the

user's personal information is extracted from the database unit 116 at step S308, and the user authentication is completed and the extracted user information is transferred to the color vision test unit 110 at step S310. If the user is not the authenticated user, the user is requested to input user registration information and the user registration information is stored in the database unit 116 at step S306. Thereafter, the user's personal information is extracted from the database unit 116 at step S308 as in the case of the authenticated user at step S308, and the user authentication is completed and the extracted user information is transferred to the color vision test unit 110 at step S310.

FIG. 4 is a diagram illustrating the details of user registration information according to the present invention. User information necessary at the time of user registration includes an ID and password 402, basic personal information 404 including the user's name, gender, age and address, the user's vision information 406, the user's other disease information 408 and the user's display device information 410. Every user has a unique ID and password, and the user's display device information is obtained by the user's manual input or automatically obtained from the user authentication unit 108 with the user's consent.

FIG. 5 is a detailed flowchart showing the color

vision test step S204 and color vision deficiency diagnosis step S206 of FIG. 2. First, a database that stores color vision deficiency results based on various color vision test results is generated at step S500. The user performs a precision color vision test, which can be performed on a computer basis, over the web at step S502, and color vision test results are stored in the database unit 116 at step S508. Color vision deficiency characteristics are automatically diagnosed based on the color vision test results at step S506, and diagnosis results are also stored in the database unit 116 at step S508. Automatically diagnosed color vision deficiency characteristics are represented in a standardized form by an MPEG-21 based color vision deficiency description method at step S510, and is also stored in the database unit 116 at step S512. Since the automatic color vision deficiency characteristic diagnosis is based on statistics, a doctor's (or a medical expert's) precision diagnosis step S514 is performed, and the color vision test and color vision deficiency diagnosis is then completed at step S516.

The color vision test step S502 includes tests capable of measuring the degree of color vision deficiency as well as the type of color vision deficiency. Equation 1 mathematically represents precision color vision test results.

$$X^k = \{x_n^k\}, k = 1, \cdots, K, \quad n = 1, \cdots, N \qquad (1)$$

where X^k is a vector that represents the user's test results in the kth of K different types of color vision tests. The color vision test is divided into N steps, and x_n^k represents color vision test results at the nth step.

The user's color vision test results are stored in the database unit 116 at step S504, and the user's color vision deficiency characteristics are automatically diagnosed using the color vision test results at step S506. The color vision deficiency characteristic diagnosis results include a color vision deficiency type and a color vision deficiency degree, and are represented by Equation 2.

$$Y^k = \{y_t^k, y_d^k\} \qquad (2)$$

where Y^k is a vector that represents color vision deficiency diagnosis results and has two elements. y_t^k is a color vision deficiency type, and y_d^k is a color vision deficiency degree. The color vision deficiency type y_t^k is represented as 'Red-deficiency' in the case of red blindness/red weakness, 'Green-deficiency' in the case of green blindness/green weakness, 'Blue-deficiency' in the case of blue blindness/blue weakness, and 'CompleteColorBlindness' in the case of total-complete blindness/partial-complete blindness. The color vision deficiency degree is numerically represented, and is

differently represented according to color vision deficiency test results. K different types of color vision tests have different automatic color vision deficiency characteristic diagnosis functions, respectively, and are represented by Equation 3.

$$X^k : Y^k \leftarrow F^k_{color\ vision\ deficiency\ diagnosis\ function}(X^k) \tag{3}$$

where $F^k_{color\ vision\ deficiency\ diagnosis\ function}$ represents the color vision deficiency characteristic diagnosis functions of the k color vision tests. The color vision deficiency characteristic diagnosis functions are statistical functions that are used to derive color vision diagnosis results Y^k through the comparison and analysis of the user's color vision test results X^k with respect to statistical data in a database.

The automatic diagnosis results of the user's color vision deficiency characteristics are represented in a standardized form using an MPEG-21 based color vision deficiency characteristic description method. The standardized MPEG-21 based color vision deficiency description method is described in Table 1.

Table 1

Medical name	Color vision deficiency description		
	Deficiency type	Deficiency degree	
		Textual degree	Numerical degree
Red weakness	red-deficiency	mild	0.1~0.9
Red blindness	red-deficiency	severe	1.0
Green weakness	green-deficiency	mild	0.1~0.9

Green blindness	green-deficiency	severe	1.0
Blue weakness	blue-deficiency	mild	0.1~0.9
Blue blindness	blue-deficiency	severe	1.0
Partial-complete blindness	complete-color blindness	mild	0.1~0.9
Total-complete blindness	complete-color blindness	severe	1.0

Since the color vision test and the automatic diagnosis of the color vision deficiency characteristics in the present invention are based on statistics, the doctor's precision diagnosis step S514 may be included to improve the reliability of diagnosis results. FIG. 6 is a detailed flowchart showing the doctor's precision diagnosis step S514 of FIG. 5.

A doctor is allowed to perform the color vision test on-line regardless of time, so that an advantage arises in that the user and doctor's time can be minimally wasted. In order to perform the `doctor's precision diagnosis, the doctor who will perform the diagnosis accesses the user authentication unit 108 of the apparatus 100, and performs user authentication in which whether he or she possesses a test authority is examined at step S602. After the authentication, the doctor loads the color vision test results of the user needing the doctor's precision diagnosis from the database unit 116. The doctor precisely diagnoses the user's color vision test results at step S606, examines automatic color vision deficiency diagnosis results using the database unit 116, and stores the precision diagnosis results in the database unit 116 at

step S608. If the precision diagnosis results are different from the automatic diagnosis results, the user's color vision deficiency characteristic description results are changed based on the precision diagnosis results, and the changed color vision deficiency characteristics are stored in the database unit 116 at step S610.

The user who has completed the color vision test and the color vision deficiency diagnosis accesses the color alteration palette generation unit 114, receives a color alteration palette optimized to the user's color vision deficiency characteristics and the display device characteristics, and installs the color alteration palette. FIG. 7 is a detailed flowchart showing the color alteration palette generation and provision step S208 of FIG. 2.

The color alteration palette generation unit 114 receives the user's color vision deficiency characteristics and the display device characteristics of the user's terminal that are stored in the database unit 116 at step S702. The color alteration palette for altering the colors of the basic palette of the display device provided in the user's terminal is generated based on the two sets of characteristics at step S704. The palette is generally represented by Equation 4.

$$A : A' \leftarrow Palette^{H}\{A\} \tag{4}$$

where H in the color palette function $Palette^{H}$ represents the display device characteristics of the user's terminal.

$A=\{R,G,B\}$ is an original color, and $A'=\{R',G',B'\}$ is a color represented by the color palette function $Palette^H$. The original color A is represented by the color A' that is dithered by the color palette function $Palette^H$. The color A' is the color closest to the original color A in the display device characteristics H.

The resulting color perception characteristics of the user having color vision deficiency act in conjunction with the user's display device characteristics as well as the user's color vision deficiency characteristics. The user's perception of the wavelengths of colors is performed by three types of cone cells, and the color characteristics thereof may be represented in spaces L, M and S. When colors are perceived on a display device, such as a monitor, the R, G and B characteristics of the display device must be considered. The amounts perceived by a human's L, M and S cone cells with regard to the wavelength characteristics of the display device are represented by the following Equation 5.

$$\begin{aligned} L_R &= \int k_l L(\lambda)R(\lambda)d\lambda \\ L_G &= \int k_l L(\lambda)G(\lambda)d\lambda \\ L_B &= \int k_l L(\lambda)B(\lambda)d\lambda \\ M_R &= \int k_m M(\lambda)R(\lambda)d\lambda \\ M_G &= \int k_m M(\lambda)G(\lambda)d\lambda \\ M_B &= \int k_m M(\lambda)B(\lambda)d\lambda \end{aligned} \qquad (5)$$

$$S_R = \int k_s S(\lambda) R(\lambda) d\lambda$$
$$S_G = \int k_s S(\lambda) G(\lambda) d\lambda$$
$$S_B = \int k_s S(\lambda) B(\lambda) d\lambda$$

When the characteristics of the color deficient person, not a normal person, are input, the reactions of the cone cells are different from those of the normal person. If the color vision deficiency degree is y_d^k, the reactions of the cone cells can be represented in terms of $p(y_d^k)$ and $q(y_d^k)$, as represented by the following Equation 6. Equation 6 represents the abnormality of the cone cell L in the case of red-deficiency. Meanwhile, the cone cells M and S are normal, as represented by Equation 5.

$$L_R^{color\ vision\ deficiency} = \int P_L(y_d^k) L(\lambda - q_L(y_d^k)) R(\lambda) d\lambda$$
$$L_G^{color\ vision\ deficiency} = \int P_L(y_d^k) L(\lambda - q_L(y_d^k)) G(\lambda) d\lambda \quad (6)$$
$$L_B^{color\ vision\ deficiency} = \int P_L(y_d^k) L(\lambda - q_L(y_d^k)) B(\lambda) d\lambda$$

where $P_L(y_d^k)$ represents the abnormality in the reaction amount of the cone cell L, and $q_L(y_d^k)$ represents the abnormal reaction of the cone cell L to the wavelength.

When the red-deficiency degree is y_d^k, the reaction of the cone cell M is represented by the following Equation 7. The cone cells L and S are normal, as represented by Equation 5.

$$\begin{aligned}
M_R^{color\ vision\ deficiency} &= \int P_M(y_d^k) M(\lambda - q_M(y_d^k)) R(\lambda) d\lambda \\
M_G^{color\ vision\ deficiency} &= \int P_M(y_d^k) M(\lambda - q_M(y_d^k)) G(\lambda) d\lambda \qquad (7) \\
M_B^{color\ vision\ deficiency} &= \int P_M(y_d^k) M(\lambda - q_M(y_d^k)) B(\lambda) d\lambda
\end{aligned}$$

where $P_M(y_d^k)$ represents the abnormality in the reaction amount of the cone cell L, and $q_M(y_d^k)$ represents the abnormal reaction of the cone cell L to the wavelength.

When the red-deficiency degree is y_d^k, the reaction of the cone cell S is represented by the following Equation 8. The cone cells L and S are normal, as represented by Equation 5.

$$\begin{aligned}
S_R^{color\ vision\ deficiency} &= \int P_S(y_d^k) S(\lambda - q_S(y_d^k)) R(\lambda) d\lambda \\
S_G^{color\ vision\ deficiency} &= \int P_S(y_d^k) S(\lambda - q_S(y_d^k)) G(\lambda) d\lambda \qquad (8) \\
S_B^{color\ vision\ deficiency} &= \int P_S(y_d^k) S(\lambda - q_S(y_d^k)) B(\lambda) d\lambda
\end{aligned}$$

where $P_S(y_d^k)$ represents the abnormality in the reaction amount of the cone cell S, and $q_S(y_d^k)$ represents the abnormal reaction of the cone cell S to the wavelength.

The color alteration palette for the color vision deficiency is generated using Equations 6 to 8 as follows. When the red-deficiency degree is y_d^k, the palette alteration is represented by the following Equation 9.

$$F_{color\ alteration}^H\{A\} = \begin{bmatrix} L_R^{color\ vision\ deficiency} & L_G^{color\ vision\ deficiency} & L_B^{color\ vision\ deficiency} \\ M_R & M_G & M_B \\ S_R & S_G & S_B \end{bmatrix}^{-1} \times$$

$$\begin{bmatrix} L_R & L_G & L_B \\ M_R & M_G & M_B \\ S_R & S_G & S_B \end{bmatrix} \times A \tag{9}$$

When the green-deficiency degree is y_d^k, the palette color alteration is represented by the following Equation 10.

$$F^H_{color\ alteration}\{A\} = \begin{bmatrix} L_R & L_G & L_B \\ M_R^{color\ deficiency} & M_G^{color\ deficiency} & M_B^{color\ deficiency} \\ S_R & S_G & S_B \end{bmatrix}^{-1} \times \begin{bmatrix} L_R & L_G & L_B \\ M_R & M_G & M_B \\ S_R & S_G & S_B \end{bmatrix} \times A \tag{10}$$

When the blue-deficiency degree is y_d^k, the palette color alteration is represented by the following Equation 11.

$$F^H_{color\ alteration}\{A\} = \begin{bmatrix} L_R & L_G & L_B \\ M_R & M_G & M_B \\ S_R^{color\ deficiency} & S_G^{color\ deficiency} & S_B^{color\ deficiency} \end{bmatrix}^{-1} \times \begin{bmatrix} L_R & L_G & L_B \\ M_R & M_G & M_B \\ S_R & S_G & S_B \end{bmatrix} \times A \tag{11}$$

Final palette color alteration is represented by the following Equation 12.

$$CVDPalette^H\{A\} = Palette\{F^H_{color\ alteration}\{A\}\} \tag{12}$$

where the palette $CVDPalette^H$ is a color alteration palette for the color deficient person. The colors displayed using the color alteration palette are represented by the

following Equation 13.

$$A : A_C \leftarrow CVDPalette^H\{A\} \tag{13}$$

where A_C represents colors that are dithered by the color alteration palette.

When the color alteration palette is generated based on the user's color vision deficiency characteristics and display device characteristics as described above, a color alteration palette installation program, which the user can install in the user's terminal, is transmitted to the user's terminal.

Thereafter, the colors displayed on the user's display device are altered using the color alteration palette installed in the color alteration unit 120 of the user's terminal 102. FIG. 8 is a detailed flowchart showing the color alteration step S210 of FIG. 2.

The user installs the received color alteration palette installation program in the user's terminal at step S802. The user's personal color alteration preference may be input at step S804, and the user may finely adjust the color alteration degree using the installed control program at step S806. The user may set a color alteration region with respect to the colors displayed on the display device at step S808. When the color alteration of a system palette that controls the display device is selected at step S810, all of the color information displayed on the display device is altered at step S814.

The above-described embodiments are used only to allow those skilled in the art to easily understand and implement the present invention, but are not intended to limit the present invention. Accordingly, those skilled in the art should note that various modifications and variations of the embodiments are possible without departing from the scope of the present invention. In principle, the scope of the present invention is defined by the claims that will be described later.

[Industrial Applicability]

In accordance with the above-described present invention, the color vision test is performed on the user having color vision deficiency over the web, the user's color vision deficiency characteristics are automatically described using test results, all or some of the colors on the display device of the user having the color vision deficiency characteristics are altered using the described color vision deficiency characteristics, thus enabling the color deficient user to perceive the same colors as a normal person.